2 March 1964

DEVELOPMENT OBJECTIVES

PROCESSOR DEVELOPMENT PROGRAM

1. SCOPE. The development objectives covered herein set forth requirements for an investigative effort relating to photographic processing equipment and techniques. The program shall make use of the present HTA/5 processor on a GFE basis as a test vehicle, for specific investigative efforts in a GFE portable clean-room environment, adequately equipped and staffed to achieve conceptual and engineering advances in the art and technology of photographic film processing.

2. INVESTIGATIVE OBJECTIVES. The investigative objectives described below are primarily directed toward improvements in the liquid-air bearing concept because of its demonstrated significant advances in the state-of-the-art of film processing. It is not intended that these objectives restrict related efforts in other processing concepts that may be conceived as a result of this work; however, any major deviation from the objectives as set forth shall be approved by the project monitor.

3. DETAILED OBJECTIVES.

3.1. Liquid and Air Bearings. The major requirement for liquid bearings and air bearings is that they should provide stable cushions for the support of film webs "in-solution", as the film passes through the solution tanks, and "in-air" as the film web crosses over from one solution to the next. To improve these functions, the following investigations should be conducted:

3.1.1. Investigate new designs, configurations and concepts for liquid and air bearings respectively, with the objective of achieving the optimal film support and tracking with the minimum of respective solution and air flow.

3.1.2. With the object of increasing the mechanical efficiency of liquid and air bearings, investigate the effect of variable slot openings as well as liquid and air feed arrangements.

3.1.3. Measure energy levels required to maintain firm cushions over a wide range of load conditions encountered by change of film width from 70mm to $9\frac{1}{2}$ inches and film thicknesses varying from 1.5 mils to 7.0 mils.

3.1.4. Establish the effect on film stability of increases or decreases in the diameter of liquid and air bearings.

3.1.5. Investigate the correlation between velocity and flow rate of solutions and air with the view of optimizing the values for each.

3.2. Air Squeegee. Investigate configurations and other parameters by which the efficiency of the air squeegee can be improved, with the minimum of air flow and/or power consumption.

3.3. Vacuum Capstans. Investigate designs for improving the vacuum capstan drive method for all applications and conditions, including:

3.3.1. Vacuum level versus volume.

3.3.2. Capstan diameters and configurations for variable film loads.

3.3.3. Determine under what conditions other materials, such as scintered metal, or teflon coatings, may be used and at what energy levels.

3.3.4. Effects of capstan configurations on tracking characteristics.

3.4. Plumbing. The requirements for large amounts of plumbing is inherent in processing equipment and contributes significantly to power losses. Effort should be expended to minimize these losses.

3.4.1. Determine which materials and fitting designs provide the least pressure drop and give the best non-leak performance.

3.4.2. Determine which pumps and seals provide the greatest efficiency with the least temperature rise of solution.

3.4.3. Investigate means of shortening the plumbing and air lines by placing service units in close proximity to the processor needs.

3.5. Solution Filtration. Filtration of solutions is required to remove large particles from solution that may cause film emulsion or base damage. This requirement has varied widely in new equipment over the years, from 0.3 micron to 20 micron particle size, with little scientific basis for the judgment.

3.5.1. Investigate the effects on film surfaces, by the liquid-air concept, with filtering at different particle size levels to establish a scientific basis for the selection of filters for solution and water.

3.6. Equipment Size.

3.6.1. Reevaluate the configuration and space required for each machine component to assure maximum utilization of machine space. Smaller bearing design may offer considerable opportunity for size reduction.

3.7. Power Consumption.

3.7.1. Reevaluate each electrically operated component to assure maximum electrical efficiency. Improvement of efficiency in liquid and air bearings and the air squeegee should greatly reduce the power required for pumping liquid and air.

3.8. Modular Design. Modular design and construction of processing equipment is of utmost importance to assure ready disassembly and reassembly for maximum portability, quicker maintenance by ready replacement of modules, less down time by ease of part replacement, and greater reliability.

3.8.1. Study modular concept with a view to:

3.8.1.1. Designing the processor in modules that are readily transportable for crating.

3.8.1.2. Keying the modules to assure proper reassembly with automatic module alignment.

3.8.1.3. Extending the modular concept to individual parts such as liquid bearings and air bearings. Intensive investigation should be directed to designing the bearings as self contained, self sufficient, electrically operated units. These should be easily removable and replaceable while the machine is operating. This may be accomplished by removable bearing cores to avoid collapse of the film strand during the interchange.

3.8.1.4. Use of multi-pin connectors for interconnecting modules.

3.9. Controllable Development Module. Controllable development has come to be recognized as a valuable asset in the processing of both original film and duplicates.

3.9.1. Investigate miniature designs of controllable development modules for insertion in the processor.

3.10. Density Measurement. Any controllable development system must include a precise method by which the densitometric characteristics of the film may be analyzed, in order to assure proper adjustment in subsequent localized processing.

3.10.1. Investigate densitometric analysis modules for use in conjunction with the controllable development module.

3.11. Splicing. Investigate new splicing methods and splicing apparatus for incorporation as an integrated module of the processor.

3.12. Reliability. One of the prime characteristics of a processor is its mechanical reliability and its ability to eliminate all possible damage to irreplaceable original film.

3.12.1. Evaluate the operational limitations of each operating component to assure absolute reliability.

3.12.2. Determine areas or functions that should have stand-by automatic switchover service units or components.

3.13. Threading. Investigate methods by which the liquid-air bearing processor may be simply threaded, preferably by automatic means.

3.14. Film Torque. An important element in modern processing is complete avoidance of any stress on the film web that may cause distortion or elongation of images by driving torque applied to the film web.

3.14.1. Devise techniques by which torque on the film web can be measured, controlled and minimized. Also establish some criteria by which the torque of the liquid-air bearing concept can be compared to that of presently standard techniques.

3.14.2. This investigation should include a measure of the torque required to draw film from the supply spool, with a view to driving the supply spool in proper synchronism with the processor drive capstan to avoid all possible stretching of the film.

3.15. Chemical Development. Investigate various chemical solutions, including viscous development with a view to reducing the space requirement without compromise of quality.

3.16. Chemical Fixation. Investigate machine chemical fixation to assure maximum efficiency within the space limitations. This should include concentrated, semi-viscous solutions.

3.17. Film Washing. Investigate film washing methods with a view to reducing the volume of wash water required, without sacrifice of archival quality.

3.18. Measure of Chemical Balance. Investigate electronic means by which the chemical balance can be continuously measured and recorded on dials attached to the side of the machine, or at the control panel.

3.19. Processor Control System. Investigate control functions for operation of the system, with a view to total centralization of required controls at the control panel.

3.20. Clean Room. Study the practical aspects of operating a processor in a clean-room atmosphere to establish parameters for a clean-room processor operation. This investigation should evaluate the effect of the room environment on the film during the processing cycle and should also evaluate the processor effect on the aerosol content of the clean-room when operated therein.

3.21. Drying Air. Investigate the particle size filtration required for drying air fed to a film drying cabinet.

3.22. Gamma Requirements. Investigate film gamma requirements as related to processing characteristics of the liquid-air bearing principle.

4. REPORTS. The contractor shall be required to submit monthly progress reports and periodic technical reports.

4.1. Monthly Reports. The monthly report shall be a letter type describing briefly the activities of the previous month and proposed work for the next month. This report shall include a monthly accounting of funds expended with an appropriate breakdown and documentation of verbal agreement made with the monitor.

4.2. Technical Reports. Technical reports shall be submitted on completion of each respective Research Objective, or at some significant point towards its accomplishment. These reports should describe the work performed with results, conclusions and recommendations.

5. ORGANIZATION. In order to assure development of a research environment conducive to the origination, development and testing of new concepts and techniques, the research group assigned to this program shall be organizationally separated from production personnel.

5.1. Personnel. Personnel chosen by the contractor to perform the research described herein shall be approved by the contract monitor.

5.1.1. Personnel assigned to this research program shall be assigned on a full-time basis.

6. CLEAN ROOM. The GFE clean-room will be provided and installed at the expense of the Government. Purchase of the clean-room and supervision of its installation shall be by the contractor. Installation shall be at some location within the contractor's plant acceptable to the contract monitor.

7. HTA/5. The GFE HTA/5 processor shall be installed in the GFE clean-room and brought to a suitable and reliable condition to properly serve as a test vehicle in any reasonable manner to accomplish the investigative objectives covered herein.

8. SECURITY. The enclosure utilized for this investigative program shall be closed to all personnel except those assigned who have proper security clearances and who have a need-to-know of work conducted therein.